

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

STREAMBANK AND SHORELINE PROTECTION

(Feet)
CODE 580

DEFINITION

Treatment(s) using structures and/or vegetation to stabilize and protect banks of streams, constructed channels, lakes, reservoirs and estuaries against scour and erosion.

PURPOSES

To stabilize or protect banks of streams, lakes, reservoirs, estuaries, or constructed channels for one or more of the following purposes:

- To prevent, control, or minimize the loss of land or damage to land uses, or other facilities adjacent to the banks, including the protection of known historical, archeological, and traditional cultural properties.
- To maintain the flow or storage capacity of the water body or to reduce the offsite or downstream effects of excessive sediment resulting from bank erosion.
- *To control channel meander that would adversely affect downstream facilities.*
- *To reduce sediment loads causing downstream damage and/or pollution.*
- To improve or enhance the stream and riparian corridor for fish and wildlife habitat, aesthetics, and recreation.

CONDITIONS WHERE PRACTICES APPLY

This practice applies to streambanks of natural or constructed channels and shorelines of lakes, reservoirs, or estuaries where they are susceptible to erosion. It

applies to controlling erosion where the problem can be solved with relatively simple structural measures, vegetation, or upland erosion control practices *(such as those described in the USDA-NRCS National Engineering Handbook, Part 653 and the Engineering Field Handbook, Chapter 16-Streambank and Shoreline Protection)* where failure of structural measures will not create a hazard to life or result in serious property damage. It also applies to vegetative and structural practices, which are intended to influence stream form, sediment transport characteristics, and the ability to support vegetation. It does not apply to erosion problems created by wave action on the open and unprotected shores of the Lake Michigan and similar areas of complexity not normally within the scope of NRCS authority or expertise.

FEDERAL, STATE, AND LOCAL LAWS

Streambank and shoreline protective measures shall comply with all federal, state and local laws, rules or regulations governing streambank and shoreline protection. The landowner/ operator is responsible for securing required permits. This standard does not contain the text of the federal, state, or local laws governing streambank and shoreline protection.

DEFINITIONS

Geomorphic Bankfull Stage – The bankfull stage corresponds to the discharge at which channel maintenance is most effective, that is, the discharge at which moving sediment, forming or removing bars, forming or changing bends and meanders, and generally doing work that results in the

<p>Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.</p>

average morphologic characteristics of channels. (Dunne and Leopold 1978) Often associated with a maximum flow which on average has a recurrence interval of 1.5 years.

Fluvial Geomorphology – The scientific study of the form and structure of the geology of an area as affected by flowing water.

Meander Geometry Formulas—Planform geometry relationships between meander length, channel width and radius of curvature for streams. Developed by Leopold (1994) and others.

Discharge Sediment Regime – A broad term that embodies the processes of erosion, entrainment, transportation, deposition, and the compaction of sediment.

Redirective Method – Any treatment method dependent on placement of material extending from the bank line into the active channel, i.e. bendway weirs, stream barbs, etc,

CRITERIA

GENERAL CRITERIA APPLICABLE TO ALL PURPOSES

Because each reach of channel, lake, or estuary is unique, measures for streambank and shoreline protection must be installed according to a plan adapted to the specific site.

Protective measures to be applied shall be compatible with improvements planned or being carried out by others.

Streambank Protection shall be started and ended at a stabilized or controlled point on the stream.

End sections shall be adequately bonded to existing measures, terminate in stable areas, or be otherwise stabilized. *Structural measures shall always be keyed into the bank at both the upstream and downstream ends, with additional keys along design reach as needed to prevent flanking. The*

keys will extend from the elevation of the anticipated scour depth to the low bank elevation and shall be keyed into the bank a minimum depth of 5 feet (measured perpendicular to the bank slope).

Riprap used for streambank or shoreline protection will be sized consistent with guidelines found in Chapter 16 of part 650 National Engineering Handbook (NEH).

Where rock riprap is used for bank or toe protection, undercutting by scour shall be prevented by one of the following methods of riprap placement:

--Key riprap into the bottom of the channel to a depth equal to the design riprap thickness or 2 feet (0.6m), whichever is greater, below the anticipated lowest scour line, or

--Design and place riprap as Stone Toe Protection (See USDA-NRCS National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices, Appendix A) in sufficient quantity to allow for launching of material into anticipated scour while maintaining design height.

The anticipated lowest scour line measured from base flow conditions shall be assumed equal to the mean geomorphic bankfull depth.

Protective measures shall be installed on stable slopes. Bank or shoreline materials and type of measure installed shall determine maximum slopes. Side slopes constructed in earth shall be 2:1 or flatter unless a slope stability analysis is conducted to support using a steeper slope.

Designs will provide for protection from upslope runoff.

Internal drainage for bank seepage shall be provided when needed. Geotextiles or properly designed filter bedding shall be used on structural measures where there is potential for migration of material from behind the measure.

Measures shall be designed for anticipated ice action and fluctuating water levels.

Measures planned shall not limit stream flow access to the floodplain.

Measures applied shall not adversely affect threatened and endangered species nor species of special concern as defined by the appropriate state and federal agencies.

Bulkheads and revetments, including prefabricated slope protection blocks, riprap, gabions, soil cement, pilings, and other geotechnical material may be used for protective measures. They must be installed according to manufacturer's recommendation or as required in construction plans or specifications

All disturbed areas around protective measures shall be protected from erosion. Disturbed areas that are not cultivated shall be protected as soon as practical after construction. Vegetation shall be selected that is best suited for the soil/moisture regime

Livestock, wildlife, vehicle, and/or people traffic shall be excluded, as appropriate.

Where possible, streambank and shoreline protection measures shall be designed to allow minimum disturbance of existing desirable vegetation.

Additional Criteria for vegetative protection and other bio-engineering practices

Protection shall extend to the design storm frequency flow elevation (geomorphic bank full) or wave height and velocity limits shall be as designated in EFM Chapter 16. Banks shall have a slope of 2 horizontal to 1 vertical or flatter.

The upper edge of stabilizing material for the toe shall extend a minimum of 1 foot or more above base flow conditions.

Soil bio-engineering features may be used as appropriate to improve stability, aesthetics and/or habitat, where:

** Artificial obstructions, such as fences, may be used to protect vegetation needed for streambank protection or to protect critical areas from damage by livestock or vehicular traffic*

** Vegetation that adversely affects the growth of desirable bank vegetation will be removed.*

** Areas are not susceptible to frequent inundation.*

Additional Criteria For Streambanks

Segments that are *incised (with bank heights greater than 130% of maximum geomorphic bankfull depth)* or contain the 5-year return period (20 percent probability) shall be designed to preclude degradation or aggregation *or excessive velocity and shear stress.*

Structural measures shall be functional for the design flow and sustainable for higher flow conditions based on acceptable risk.

Clearing to remove stumps, fallen trees, debris, and bars shall only be done when they are causing or could cause detrimental bank erosion or structural failure. *Large woody debris removed from the channel or the streambanks may be incorporated, if practicable, into the overall practice design.* Habitat forming elements that provide cover, food, pools, and water turbulence shall be retained or replaced to the extent possible.

Measures shall not create additional hazards to upstream or downstream reaches.

When water surface elevations are a concern, the effects of protective measures shall not increase flow levels above those that existed prior to installation.

Fallen trees, stumps, debris, minor ledge outcroppings, and sand and gravel bars that may cause local current turbulence and deflection may be removed.

Additional Criteria For Shorelines

All revetments, bulkheads, or groins are to be no higher than 3 feet (1m) above mean high water,

Structural shoreline protective measures shall be keyed to a depth to prevent scour during low water.

For the design of structural measures, the site characteristics below the waterline shall be evaluated for a minimum of 50 feet (15m) horizontal distance from the shoreline measured at the design water surface.

The height of the protection shall be based on the design water surface plus the computed wave height and freeboard.

When vegetation is selected as the protective treatment, a temporary breakwater shall be used during establishment when wave run up would damage vegetation.

Vegetation shall be selected that is best suited for the soil/moisture regime. Local native species are preferred.

Additional Criteria For Stream Corridor Improvement

Stream corridor vegetative components shall be established as necessary for ecosystem functioning and stability. The appropriate composition of vegetative components is a key element in preventing excess long-term channel migration in re-established stream corridors.

Measures shall be designed to achieve any habitat and population objectives for fish and wildlife species or communities of concern as determined by a site-specific assessment or management plan. Objectives are based

on the survival and reproductive needs of populations and communities, which include habitat diversity, habitat linkages, daily and seasonal habitat ranges, limiting factors, and native plant communities. The type, amount, and distribution of vegetation shall be based on the requirement of the fish and wildlife species or communities of concern to the extent possible.

Measures shall be designed to meet any aesthetic objectives as determined by a site-specific assessment or management plan. Aesthetic objectives are based on human needs, including visual quality, noise control, and microclimate control. Construction materials, grading practices, and other site development elements shall be selected and designed to be compatible with adjacent land uses.

Measures shall be designed to achieve any recreation objective as determined by a site-specific assessment or management plan. Recreation objectives are based on type of human use and safety requirements.

CONSIDERATIONS

An assessment of streambank or shoreline protection needs shall be made in sufficient detail to identify the causes contributing to the instability (e.g. major development in contributing watershed causing more frequent occurrence of bank-full discharge and increased sediment delivery to the stream). Due to the complexity of such an assessment, an interdisciplinary team should be utilized.

Stage of channel evolution is the primary diagnostic variable for differentiating between local and systemwide channel stability problems.

Stream segments to be protected shall be assessed using the Stream Classified System (Rosgen, 1996) or a Channel Evolution Model (Simon, 1989 or Schumm, et al., 1984). (See USDA-NRCS National Engineering Handbook, Part 653, Stream Corridor Restoration: Principles, Processes, and Practices for a description of stream classification systems and channel evolution models.) Stream segments to be protected shall have measures designed that are applicable to the appropriate channel evolution stage.

Appropriate Streambank Protection Measures

Appropriate Streambank Protection Measures						
Primary Treatment	Channel Evolution Model (CEM) Stage (Schuum)					
	Alternatives	1	2	3	4	5
Vegetative		X	--	--	X	X
Toe Protection		X	--	--	X	X
Grade Control		--	X	X	--	--
Redirective Methods		X	--	--	--	--
Armoring		X	--	--	X	X

Changes in channel alignment shall not be made unless the changes are based on an evaluation that includes an assessment of both upstream and downstream fluvial geomorphology *and meander geometry formulas*. The current and future discharge-sediment regime shall be based on an assessment of the watershed above the proposed channel alignment. (See USDA-NRCS National Engineering Handbook, Part 653, *Stream Corridor Restoration: Principles, Processes, and Practices*)

When protecting improvements such as utilities, roads, buildings, or other facilities, consideration should be given to items such as cost of stabilization compared to the value of the structure, the possibility of relocating the structure, the remaining service life of the structure, and the effect of the stabilization on the future management system of the landowner.

When designing protective measures, consider the changes that may occur in the watershed hydrology and sedimentation over the life of the measure.

Large woody debris may be placed and anchored when necessary, to provide armor protection for streambanks, influence velocity distributions and sediment movement, and provide aquatic habitat

Upland and riparian management practices should be considered to improve ecological condition.

Where boaters, swimmers, or other people will be using the shoreline or streambank, design measures to minimize safety hazards.

Use construction materials, grading practices, vegetation, and other site development elements that minimize visual impacts and maintain or complement existing landscape uses such as pedestrian paths, climate controls, buffers, etc. Avoid excessive disturbance and compaction of the site during installation.

Vegetative measures should be considered on slopes above geomorphic bankfull elevation. Use natural fiber fabric when needed for short-term stabilization rather than grass seeding if possible.

Utilize vegetative species that are proven effective for the measures applied and are native and/or compatible with local ecosystems. If native plant materials are not adaptable or proven effective for the planned use, then non-native species may be used. Consider species that have multiple values such as those suited for biomass, nuts, fruit, browse, nesting, aesthetics, and tolerance to locally used herbicides. Avoid species that may be alternate hosts to disease or undesirable pests. Species on the noxious plant list should not be used. Refer to the Illinois NRCS Field Office Technical References File, Sec. I, "Invasive Plants, Changing the Landscape of America" for plant materials identified as invasive species.

Livestock exclusion should be considered during establishment of vegetative measures and appropriate grazing practices applied after establishment to maintain plant community integrity. Wildlife may also need to be controlled during establishment of vegetative measures. Temporary and local population control methods should be used with caution and within state and local regulations.

Measures that promote beneficial sediment deposition and the filtering of sediment,

sediment-attached, and dissolved substances should be considered.

Consider maintaining or improving the habitat value for fish and wildlife, including lowering or moderating water temperature, and improving water quality.

Consideration should be given to protecting side channel inlets and outlets from erosion.

Toe rock should be large enough to provide a stable base and graded to provide aquatic habitat.

Consider maximizing adjacent wetland functions and values with the project design and minimize adverse effects to existing wetland functions and values.

When appropriate, establish a buffer strip and/or diversion at the top of the bank or shoreline protection zone to help maintain and protect installed measures; improve their function; filter out sediments, nutrients, and pollutants from runoff; and provide additional wildlife habitat.

Consider conservation and stabilization of archeological, historic, structural, and traditional cultural properties when applicable.

Protective measures should be self-sustaining or require minimum maintenance.

PLANS AND SPECIFICATIONS

Plans and specifications shall be prepared in accordance with the criteria of this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An operation and maintenance plan shall be prepared for use by the owner or others responsible for operating and maintaining

the system. The plan shall provide specific instructions for operating and maintaining the system to ensure that it functions properly. It shall also provide for periodic inspections and prompt repair or replacement of damaged components or erosion.

REFERENCES

Rosgen, 1996. *Applied River Morphology*. Wildland Hydrology, Colorado.

Simon, 1989. A model of channel response in distributed alluvial channels. *Earth Surface Processes and Landforms* 14(1): 11-26.

Schuum, Harvey and Watson, 1984. *Incised channels: morphology, dynamics and control*. Water Resources Publications, Littleton, Colorado.

Westbrooks, R. 1998. *Invasive plants, changing the landscape of America: Fact Book*, Federal Interagency Committee for the Management of Noxious and Exotic Weeds (FICMNEW), Washington, D.C. 109 pp.